AMENDMENTS TO THE SPECIFICATION

Please replace paragraph [004] with the following:

[004] Today, there are various types of 3-D input devices such as those based on the measurement of magnetic [[field]] fields, photometric stereo and acoustic time-of-flight, and a joystick. The devices based on the measurement of magnetic [[field]] fields and photometric stereo carry out desired measurement of translation and rotation using a transmitter and receiver. The joystick includes a precision mechanical link to convert its movement to 3-D position information. The photometric stereo obtains 3-D position information from information of parallax using multiple TV cameras.

Please replace paragraphs [008] and [009] with the following:

[008] An object of the present invention is to provide an input device of 3-D translation and rotation and its method that can carry out stable visceral 3-D input over a wide range at arbitrary measuring time intervals without the effect of electric ~~field, or temperature with~~ fields or temperature, and requiring a small installation space.

[009] To accomplish the foregoing object, according to a 1st aspect of the present invention, there is provided an input device of 3-D translation and rotation for measuring 3-D translation and rotation of a photo device with respect to a display emitting a bright spot, the input device of 3-D translation and rotation comprising: a display with a display surface on which a bright spot is movable[[:]]; a photo device including a condense unit for condensing a bright spot on the display to be projected onto a projection plane, on which multiple photo detectors are disposed for detecting a projection position of the spot light on the projection plane;

correspondence means for bringing a bright spot display position on the display into correspondence with a projection position of the spot light on the photo detectors; and an extrinsic parameter calculator for calculating the 3-D translation and rotation of the photo device with respect to the bright spot moving surface of the display from a set of multiple bright spot display positions and their projection positions which are brought into correspondence by the correspondence means.

Please replace paragraphs [011] and [012] with the following:

[011] According to a 3rd aspect of the present invention, the photo detectors with spot-like photo windows may consist of three photo detectors, and the bright spot display positions and the projection positions, which are brought into correspondence by the correspondence means, and which may have three positions[[,]] each.

[012] According to a 4th aspect of the present invention, the photo detectors with spot-like photo windows may consist of at least five photo detectors, and the bright spot display positions and the projection positions, which are brought into correspondence by the correspondence means, and which may have at least five positions[[,]] each.

Please replace paragraph [023] with the following:

[023] According to a 15th aspect of the present invention, the correspondence means may [[comprises]] comprise: means for bringing a projection image position of the spot light on the photo detectors into correspondence with projection time, the projection image position of the spot light being a position formed by projecting the bright spot on the display onto the projection plane of the photo device; means for recording the projection position and projection time; and a

correspondence detector for bringing bright spot display positions at multiple times into correspondence with their projection positions in accordance with the recorded projection time.

Please replace paragraph [033] with the following:

[033] According to a 25th aspect of the present invention, there is provided an input method of 3-D translation and rotation for measuring 3-D translation and rotation of a photo device with respect to a display emitting a bright spot, the input method of 3-D translation and rotation comprising the steps of: moving the bright spot freely on a display surface of the display[[:]] ; condensing the bright spot on the display, and detecting a projection position of the spot light projected onto a projection plane; bringing a bright spot display position on the display into correspondence with the projection position of the spot light on photo detectors; and calculating the 3-D translation and rotation of the photo device with respect to the bright spot moving surface of the display from a set of multiple bright spot display positions and their projection positions which are brought into correspondence.

Please replace paragraphs [041] and [042] with the following:

[041] The input device of the 3-D translation and rotation in accordance with the present invention can consist of only the semiconductor device capable of detecting the projection image position, and the display for moving or scanning the bright spot on its 2-D display surface so that the input device can be implemented, which requires only a small installation space and can achieve reliable 3-D measurement free from the influence of the magnetic field or temperature. By measuring the 3-D translation and rotation at three points using the three photo detectors, the 3-D translation and rotation can be measured at minimum time intervals. In addition, by

bringing the bright spot display positions at any multiple times into correspondence with their projection positions on the photo device in accordance with the recorded time, and by calculating the 3-D translation and rotation of the photo device with respect to the bright spot moving surface or the bright spot scanning surface of the display from the set of the arbitrary number of the bright spot display positions and their projection positions, the calculation of the 3-D translation and rotation can be implemented from the arbitrary number of the bright spots at arbitrary positions and their projection image positions. This offers an advantage of being able to achieve the visceral 3-D input over a wide range without being affected by the scanning interval of the display.

[042] The input device of the 3-D translation and rotation in accordance with the present invention can consist of only the semiconductor device capable of detecting the projection image position, and the display for moving or scanning the bright spot on a 2-D surface so that the input device can be implemented, which requires only a small installation space and can achieve reliable 3-D measurement free from the influence of the magnetic field or temperature. By measuring the 3-D translation and rotation at three points using the three photo detectors, the 3-D translation and rotation can be measured at minimum time intervals. In addition, by bringing the bright spot display positions at any multiple times into correspondence with their projection positions in accordance with the recorded time, and by calculating the 3-D translation and rotation of the photo device with respect to the bright spot moving surface or the bright spot scanning surface of the display from the set of the multiple bright spot display positions and their projection positions, the calculation of the 3-D translation and rotation can be implemented from the multiple sets of minimum 3 projection images abstracted from arbitrary number of the projection images at arbitrary positions and the associated bright spot display positions. This

offers an advantage of being able to achieve the visceral 3-D input over a wide range without being affected by the scanning interval of the display.

Please replace paragraph [065] with the following:

[065] Fig. 1 is a perspective view illustrating an embodiment of an input device of 3-D translation and rotation in accordance with the present invention. In Fig. 1, the reference numeral 1 designates a ~~raster-type~~ raster-type display (called ~~display~~ "display" from now on), 2 designates a photo device, and 3 designates a 3D-position output module.

Please replace paragraph [067] with the following:

[067] Fig. 2 is a perspective view showing a configuration of the photo device 2 in a first embodiment in accordance with the present invention. In the present embodiment, the photo device 2 consists of multiple photo detectors for converting light intensity into an electric signal. In Fig. 2, the reference symbol A designates a lens, B designates a projection plane of light passing through the lens A, C designates a center at which the optical axis of the lens intersects with the light projection plane B, D designates photo detectors, and F designates the face of a ~~raster-type~~ raster-type display. The photo detectors D are disposed on the projection plane B. At least three photo detectors D must be provided, and five or more photo detectors are preferable because they make it possible to achieve wide range measurement at any desired time intervals by implementing measurement of the 3-D translation and rotation using three or four of them. The display surface F is irradiated with electron beams at every fixed interval, on which a high brightness spot moves at a high speed along the arrow G. In this case, each photo detector D

exhibits its peak output when the high brightness spot passes the intersection (H, for example) of the display surface F with the line connecting the photo detector D and the center of the lens A.

Replace paragraph [079] with the following:

[079] This equation shows that the matrices R and T can be obtained as a solution of the simultaneous linear equations for [[n □ 3]] n ≥ 3. Thus, the translation and rotation of the photo device 2 can be obtained when there are three or more sets of the points on the display surface and their corresponding point on the photo detectors.

Replace paragraph [084] with the following:

[084] When spot light is projected on the position sensitive light detector 21, it outputs the detection position (X, Y) of the spot, and transfers it to the time-and-position detector [[9(step S11)]] 9 (step S11). On the other hand, detecting the vertical sync signal of the display 1 (step S12), the counter 5 uses the signal as its reset signal and starts counting (step S13). When detecting no sync signal, the counter 5 increments its count by one and supplies its output to the time-and-position detector 9 (step S14). The time-and-position detector 9 supplies the correspondence detector 7 with the detection position of the spot light and count value (Xr, Yr, T) (step S15).

Replace paragraph [087] with the following:

[087] Fig. 10 is a perspective view showing a configuration of a photo device of a third embodiment in accordance with the present invention, which comprises multiple condense units and photo detectors to carry out ~~wider range condense~~ a wider range of condensing. Although

the example as shown in Fig. 10 includes four sets of condense units and photo units disposed in such a manner that optical axes of the four sets intersect perpendicularly to each other, the number of the condense units and photo units, or the angles between the optical axes can be determined freely. The operation principle is the same as that of the foregoing first and second embodiments.

Replace paragraph [0107] with the following:

[0107] The projection board 71 is made translucent so that the bright spot of the laser light irradiated from the lay-projection module 74 undergoes diffused reflection on the bottom surface of the projection board 71 to display only the bright spot on the top surface of the projection board 71. The present apparatus supposes the 3-D input to a PC without a ~~raster type~~ raster-type display, and transmits the 3-D translation and rotation of the photo device 72 with respect to the projection board 71 to the personal computer 75 connected therewith.

Please replace the Abstract of the Disclosure with the following:

A photo device condenses the bright spot on the display to project the spot light onto the projection plane, thereby projecting it onto photo detectors the projection plane. A counter counts the time from the time of a vertical sync signal[[,]] and supplies its output to AND gates. A correspondence detector brings bright spot display positions on the display at multiple times into correspondence with their projection positions on the photo device in accordance to recording time. An extrinsic parameter calculator calculates the 3-D translation and rotation of the photo device with respect to the bright spot scanning surface of the display from at least three sets of the bright spot display positions and their corresponding projection positions.